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Preliminary Evaluation of *Psuedomonas solanacearum* as a Potential Biological Control Agent for the Alien Weed Kahili Ginger (*Hedychium gardnerianum*) in Hawaiian Forests

Robert C. Anderson and Donald E. Gardner
Cooperative National Park Resources Studies Unit
Department of Botany University of Hawai'i at Mānoa

Kahili ginger (*Hedychium gardnerianum* Ker-Gawl), native to the Himalayas (Neal, 1965), is a pest in Hawaiian forests (Smith, 1985; Santos *et al.*, 1986; Nagata, 1990). Brought to Hawai'i by the horticultural industry, it has escaped cultivation and is now naturalized in the state. First collected in 1954 at Hawai'i Volcanoes National Park (HAVO) (Wester, 1992), populations are now found on all islands between sea level and 1,700 m (Smith, 1985). Smith (1985) lists it as a pest on the islands of Kaua'i, Maui, and Hawai'i; and present but not a pest on O'ahu and Moloka'i. Nagata (1990) reported that kahili ginger is now also naturalized on Lana'i.

Kahili ginger is a cold-tolerant species found in its native habitat at elevations up to 2,500 m. Open inflorescences, about 25 cm in length, develop at the tips of the pseudostems, which themselves can reach over 2 m in height (Neal, 1965). In Hawai'i, flowering occurs from July through

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Published by the Hawaiian Botanical Society, which was founded in 1924 to "advance the science of botany in all its applications, encourage research in botany in all its phases, promote the welfare of its members and develop the spirit of good fellowship and cooperation among them." Any person interested in the plant life of the Hawaiian Islands is eligible for membership. Information may be obtained from the Society:

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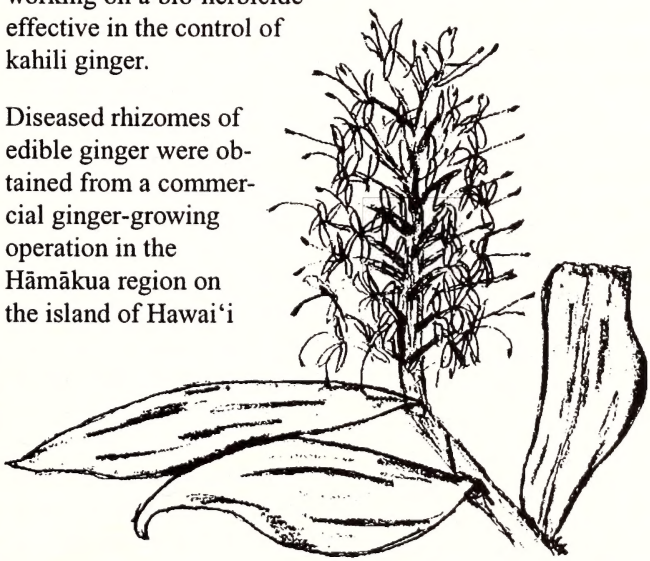
Continued from page 1

September. Seeds are numerous, exposed, and bright red; observations of seed predation suggest dispersal may be by frugivorous birds. A very aggressive, shade-tolerant plant, it has the ability to establish itself under dense canopies and has become naturalized in the ʻōhiʻa (*Metrosideros polymorpha* Gaud.) forests, as well as open areas in and around HAVO. Kahili ginger can invade and establish itself in intact native rain forest habitat, where it can form dense monotypic stands 2-3 m in height in the understory and displace native vegetation. Kahili ginger reproduces both vegetatively, via its massive rhizome system, and sexually, through the dispersal of seeds, although the first is more common (Santos *et al.*, 1986).

Previous attempts at mechanical and herbicidal control of kahili ginger have failed to provide a method that is both cost effective and environmentally safe (Santos *et al.*, 1986). When these control efforts fail, biological control is often the best long-term solution for controlling invasive weeds (Smith, 1985). In support of the cooperative effort by state and federal agencies in the biological control of invasive alien weed species in Hawaiʻi, a bacterial wilt disease of edible ginger (*Zingiber officinale* Roscoe) caused by *Psuedomonas solanacearum* E. F. Smith was brought to our attention as a possible biological control agent against kahili ginger. Upon collection of diseased edible ginger rhizomes, we isolated *P. solanacearum* to begin working on a bio-herbicide effective in the control of kahili ginger.

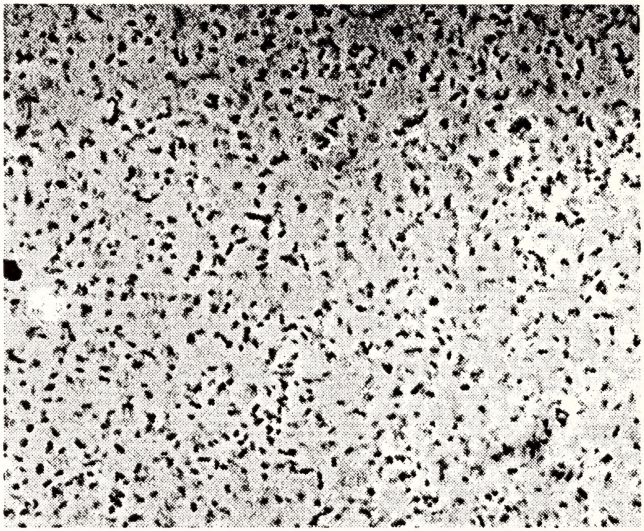
Diseased rhizomes of edible ginger were obtained from a commercial ginger-growing operation in the Hāmākua region on the island of Hawaiʻi in May 1994. Bacteria were readily isolated from rotting shoot tips using standard methods. Pathogenicity of *P. solanacearum* was tested on kahili and white ginger (*H. coronarium* J. König). Young plants (45-65 cm tall) with rhizomes were collected from the area around the Research Center in HAVO and transported to the greenhouses at the University of Hawaiʻi at Mānoa.

Injection of 2-4 ml of bacterial suspension into the pseudostems of the plants proved to be the best method of inoculation. In-



Hedychium gardnerianum

jections were made about 5 cm above the soil level with a hypodermic syringe after the outermost leaf-sheath was pulled down to expose a clean surface. Injections were deep enough to insure penetration to the center of the pseudostem. Successful inoculations were indicated by a water-soaked appearance of the pseudostem at and above the inoculation site. Control plants were injected with sterile distilled water. Twenty-two and 30 plants of kahili and white ginger, respectively, were inoculated with the current strain of *P. solanacearum*.



Pseudomonas solanacearum *(2,000 X)*

The first visible symptoms of bacterial wilt on kahili ginger are a flagging of the young leaves along the midrib, followed by chlorosis of the entire leaf. The wilt spreads to the more mature leaves, followed by complete yellowing and browning of the entire pseudostem. Under favorable conditions for disease development, the entire pseudostem becomes flaccid and wilts with distinct yellowing and browning of the pseudostem. Young emergent pseudostems frequently become soft and completely rotted; the diseased pseudostem breaks off easily from the underground rhizome at the soil line. The bacterial wilt is initially manifested only on inoculated shoots. However, in time the entire rhizome usually becomes affected.

Once the rhizome becomes infected, grayish-brown discoloration of the rhizomes may be localized or general. Browning is usually more pronounced along the boundary of the cortex from the stele, resulting in a water-soaked appearance of the entire central cylinder. When infected rhizomes create a mass of new shoots, the shoots often develop the disease within 2 weeks of emerging. In advanced stages, the bacteria break out into pockets within the rhizome, causing extensive browning and breakdown of tissue and producing an offensive odor unlike that of healthy plants. Severely diseased rhizomes often become completely rotted and disintegrate into the soil within 4-6 weeks after becoming infected. Roots also become infected, and unlike healthy roots, are easily crushed with minimal pressure.

Seventy-two percent of inoculated kahili ginger plants became infected and wilted extensively. Visible symptoms appeared 4-6 weeks after inoculation; complete wilt and browning of the pseudostems occurred within 30 days of observing the first symptoms. Characteristic systemic infection of the vessels and ultimate breakdown of the rhizomes occurred within 45 days of psuedostem death. No infection occurred in the controls or the white ginger.

The results of the pathogenicity tests indicate that kahili ginger is highly susceptible to *P. solanacearum*. Nearly three-quarters of the inoculated kahili ginger plants died within four weeks of the notice of initial symptoms. The results of the white ginger inoculations are intriguing. Knowing that edible ginger is susceptible to *P. solanacearum*, and observing the same reaction on kahili ginger, one would hypothesize that white ginger would also be susceptible. The results indicate otherwise, even following repeated inoculations. Inoculated white ginger plants continued to grow normally after inoculation and eventually flowered. Perhaps the white ginger is resistant to only the current strain being used for inoculations. Although white ginger is also a weed in HAVO, it does not invade intact forests like kahili ginger does. Because white ginger is largely confined to open areas and roadways in HAVO, it is more amenable to mechanical control.

The results of this experiment presents interesting possibilities for resource managers in the effort to control kahili ginger in HAVO. Since *P. solanacearum* is already established in Hawai'i, it is an excellent candidate pathogen for the biological control of kahili ginger. The usual involved and restrictive processes of importing a biological control agent to Hawai'i can be avoided. Because kahili ginger is usually found in conservation districts, the threat of the bacterial disease spreading to areas where commercial operations occur is minimal. Although the greenhouse experiments look promising, the main emphasis now is to establish its effectiveness under field conditions at high elevations (> 1,000 m). The ability of this disease to survive diurnal temperature changes at higher elevations is a crucial factor for its success as a biological control agent, because many infestations of kahili ginger in Hawai'i occur between 1,000-1,500 m. The development of different protocols for field application of *P. solanacearum* in natural areas should also be investigated.

Acknowledgements

The authors would like to thank Dr. Eduardo Trujillo and Dr. David Norman, Department of Plant Pathology, University of Hawai'i for their help and use of materials during this project. We would also like to thank Tom Meninzes, commercial ginger grower, for donating ginger rhizomes diseased with *P. solanacearum*. This project was supported through the Cooperative National Park Resources Studies Unit by National Biological Service biological research funding.

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Plant Raffle Scheduled for May Meeting

At our May meeting we will be holding our traditional Plant Raffle.

Please bring in any plants you would like to donate. In the past we have had both exotic species and native Hawaiian plants donated for the raffle. If you have extra plants you would like to share with Society members and help us raise badly needed funds, bring your plants to the May meeting.

If you don't have any plants to donate, bring your money. Raffle tickets are only $3.00 a ticket and when your number is called you can choose any plant out of those available. Everyone goes away happy.

Shoot Proliferation in Micropropagated *Jacquemontia ovalifolia* (Choisy) H. Hallier ssp. *sandwicensis* (A. Gray) K. Robertson

Kay Lynch
Tissue Culture Directed Study with Dr. Yoneo Sagawa
University of Hawai'i, Spring, 1995

Abstract

In two trials with medium containing different concentrations of BA to achieve shoot proliferation in *Jacquemontia ovalifolia* (Choisy) H. Hallier ssp. *sandwicensis* (A. Gray) K. Robertson, the medium with the higher level of BA (1.0 mg/L) produced better results. Explants taken from terminal vine sections produced clean cultures, side shoots, and vigorous plantlets with greater frequency than explants taken from older vine sections. The results suggest that *J. ovalifolia* ssp. *sandwicensis* may be a good candidate for micropropagation to attain quantities of plantlets for landscape use studies.

Introduction

J. ovalifolia is an indigenous coastal-strand vine, similar to morning glory but with smaller leaves, of the family Convolvulaceae. The subspecies, *sandwicensis,* is endemic (Wagner et al. 1990). It is found on all of the main Hawaiian islands. The plant's Hawaiian name is pā'ūohi'iaka, skirt of Hi'iaka. Its leaves and stems formerly were used medicinally by Hawaiians. *J. ovalifolia* ssp. *sandwicensis* is attractive — sprawling sparsely over black lava rock or sandy areas. It produces tiny, pale-blue or white flowers throughout the year. *J. ovalifolia* ssp. *sandwicensis* may have landscape uses as a ground accent in native plantings.

Once a plant has been successfully established in *in vitro* culture shoot multiplication can be attempted by subculturing the plantlets onto new medium containing the plant growth regulator (PGR) BA. Plants respond differently to exogenous-hormone treatments. Too much BA can inhibit shoot proliferation in some species. The purpose of this experiment was to assess the sensitivity to BA of *J. ovalifolia* ssp. *sandwicensis,* to begin to establish a protocol for micropropagation.

Materials and Methods

Set 1. On March 1, 1995, terminal vine sections of *J. ovaliformis* ssp. *sandwicensis* were collected from a southern O'ahu shoreline. Axillary and terminal buds were disinfested with 10 percent and 5 percent concentration Clorox (bleach) soaks. Buds were placed in modified Murashige and

Table 1. Results of two attempts, using BA in different concentrations, to achieve proliferation of shoots from meristems of *Jacquemontia ovalifolia* ssp. *sandwicensis*

	Total Explants	With multiple shoots	Number of shoots 1	2	3	4	Number w/ roots	Callus only
Set 1								
0.5 mg BA	6	50%	3	3	—	—	—	—
1.0 mg BA	7	66%	1	4	—	—	—	2
Set 2								
0.5 mg BA	22	27%	15	3	3	—	3	1
1.0 mg BA	22	50%	8	9	1	1	3	—

Skoog (MS) medium, 20 grams sucrose, without PGRs, using standard sterile technique. After one week, half of the cultures were contaminated. All of the contaminated explants were older buds from farther back on the vines.

Surviving shoots from Set 1 were subcultured after three weeks. Apical and axillary buds, leaf sections, petiole sections, and internode sections were placed on modified MS medium containing BA at a concentration of either 0.5 mg/L or 1.0 mg/L.

Set 2. Cuttings for Set 2 were taken on March 22, disinfested by the same procedure, and also placed on plain, modified MS medium without PGRs. Only apical buds and younger axillary buds were selected for explants. After one week, all cultures remained clean. Shoots were subcultured after two weeks; buds and leaf sections were placed on BA medium of either 0.5 mg/L or 1.0 mg/L concentration.

Results

Data were taken April 26. Set 1 had been in culture a total of eight weeks; Set 2, four and a half weeks. In both sets, buds in 1.0 mg/L BA medium produced more shoot proliferation and growth than those in 0.5 mg/L BA medium. The difference in shoot proliferation was dramatic in Set 2. Table 1 shows percentages and numbers of plantlets that developed multiple shoots. Some leaf, stem and petiole sections on 1.0 mg/L BA medium produced small amounts of callus.

Shoot proliferation on 0.5 mg/L BA. In Set 1, three of six explants produced two shoots each. The other three produced one shoot. In Set 2, six of 22 explants produced multiple shoots.

Shoot proliferation on 1.0 mg/L BA. In Set 1, four of seven explants produced two shoots each. In Set 2, 11 of 22 explants produced either two, three, or four shoots.

Shoot vigor. New shoots of Set 1 ranged in height from ¼ inch to 1½ inches in both BA treatments, but those in the 0.5 mg/L BA medium were spindly. New shoots of Set 2 explants in 0.5 mg/L were the same height and more vigorous, although they had been on BA medium only three weeks, as opposed to five for Set 1. New shoots of Set 2 explants in 1.0 mg/L BA showed vigorous growth and ranged to 3½ inches in height.

Roots. The experimental objective did not include root proliferation but roots were observed on six of 44 cultures in Set 2. Three of the rooting plantlets were on the weaker BA medium and three were on the stronger-concentration BA medium.

An anomaly. Not included in the above results was one plantlet from Set 1 that was never subcultured or transferred to medium containing BA. Without benefit of hormones, it produced side shoots, one of which had basal branching, and a number of roots.

Discussion

The experiment was performed twice because of the possibility that one or two culture tubes were mislabeled as to BA concentration during the first trial. If they were, it might explain the proportionally high number of branching shoots in the 0.5 mg/L BA treatment in Set 1, compared to the low proportion of shoots from the same treatment in Set 2. The Set 2 results, involving no chance of mix-ups and a larger number of explants, are considered reliable.

The greater vigor of shoots in Set 2 may have been due to the fact that each culture tube contained three or four explants rather than two. Ethylene is known to affect plant development in ways not well understood (Hartmann et al. 1990; Mudge 1988).

Incidental rooting of plantlets in Set 2 (even while not on a rooting medium) contributes to the impression that *J. ovalifolia* ssp. *sandwicensis* will respond well to micropropagation techniques.

Conclusion

J. ovalifolia ssp. *sandwicensis* proliferates shoots more readily in medium with a concentration of 1.0 mg/L BA than in medium with 0.5 mg/L concentration. These trials prepared the way for rooting studies to develop a complete protocol for micropropagation.

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Urgent Genetic Conservation Program

Executive Summary

Gary Ray
Center for Plant Conservation — Hawai'i

The Hawai'i Office of the Center for Plant Conservation (CPC-Hawai'i) is developing an emergency initiative aimed at preventing the total genetic loss of 129 of the state's most critically endangered plant species. The program consists of 14 interdependent funding proposals designed to collect, propagate, or store all taxa on the priority list. The initiative seeks to upgrade germplasm banks and living collections, and includes a plan to construct nurseries at higher elevations on most of the main islands. The new network of nurseries will create genetic reservoirs vital to the survival of most of the imperiled species.

The "Urgent Genetic Conservation Program" for critically endangered Hawaiian plants has evolved out of strategy sessions from a multi-agency body called the Hawaii-Pacific Plant Recovery Coordinating Committee, created and currently chaired by the US Fish and Wildlife Service. With the CPC-Hawai'i Office in a lead role, the initiative is benefiting from the cooperation and support of the Hawai'i Rare Plant Restoration Group, a large coalition of off-site and on-site conservation partners.

Hawai'i has already lost approximately 100 plant taxa to extinction. Habitat alteration from development, exotic plant and insect infestation, conflicting managerial mandates for controlling destructive feral ungulates, and the cascading effects of these factors on plant reproductive biology are creating enormous difficulties for Hawaiian plant conservation. While state, federal, and private organizations are investing in the protection of rare and endangered plant habitat, threats to most plant species can not be controlled for various political and technical reasons. It is essential that **off-site** strategies (protective cultivation in gardens and nurseries) become *central* to plant conservation planning in Hawai'i. Off-site plant conservation is our most potent weapon against the total genetic loss of a species. A fully-funded Genetic Conservation Program underwrites a sound insurance policy against the total genetic extinction of any more Hawaiian plants. Such a strategy effectively allows agencies charged with protecting the nation's endangered plants the time to plan and execute habitat protection programs, and ultimately, the option, to fully recover a plant taxon that would otherwise become extinct.

Natural population of 596 plant taxa are tracked by the conservation community in Hawai'i — more that half of the indigenous flora. While approximately 375 taxa meet criteria for federal listing as endangered, only 199 have been

listed to date. Congress has halted new endangered species listings, sharply reducing funding opportunities under Sections 6 and 7 of the Endangered Species Act.

The magnitude of the crisis, and the fiscal austerity at the state and federal levels, have prompted plant conservationists to shift their attention to 129 of our most critically endangered plants. Hawai'i has 115 taxa consisting of 20 or fewer individuals (or a single population of 50 or fewer individuals) remaining in the wild. Virtually all of these plants are single-island endemics, most with only one natural population extant. Scores of these plants are not yet secure. For instance, a recent inventory has revealed that, of the 115 extant taxa on the Safety Net list, only 34 (30%) have been incorporated into the Lyon Arboretum's tissue culture storage facility, which is nearly filled to capacity. A massive budgetary shortfall within the Hawai'i State Government has destabilized funding for a key micropropagation specialist position at Lyon. The Urgent Genetic Conservation Program intends for full funding for this position, which is tightly linked to the fate of endangered plants suffering reproductive failure in the wild.

The Urgent Genetic Conservation Program invests in the three types of genetic reservoirs integral to off-site protection strategies: (1) germplasm banks, e.g., seed banks and *in vitro* storage, (2) living collections at botanical gardens, and (3) remote "field gene banks" housed in a network of small nurseries at middle elevations. The Program calls for construction and operation of five mid-elevation nurseries on Kaua'i, O'ahu, Moloka'i, Lana'i, and Maui. Each nursery will employ a horticulturist skilled in the propagation of Hawaiian rare plants. Potential partners are a mixture of community-based non-profit groups, state agencies partnerships, two federal agencies (USFWS and the US Army), and large land-owning corporations.

The initiative seeks to establish a new system for monitoring natural populations of critically endangered plants. By combining the talents of our best field botanists, exceptionally dedicated natural resource technicians, and student interns and volunteers, we will assemble a network of committed persons that will collect population data necessary for scientifically sound genetic sampling (off-site conservation) and specialized monitoring of natural populations (on-site conservation). In this way, a single management effort serves two indispensable facets of plant protection and recovery.

CPC-Hawai'i will function as a data center to track the movement of germplasm, to monitor the progress of the program, and to ensure that no vulnerable plants are overlooked. In most cases, CPC-Hawai'i will facilitate the work of other organizations in implementing the initiative. In some instances, CPC-Hawai'i will enter into contractual agreement to execute tasks.

U.S. Fish and Wildlife Service Issues Revised List of "Candidates" for Endangered Species List

The U.S. Fish and Wildlife Service has issued a notice of review for plant and animal species that are candidates for listing as endangered or threatened under the Endangered Species Act. The revised list of "candidate species"—part of the Administration's commitment to improve implementation of the Endangered Species Act—is the result of a thorough review of the scientific information available on the species. In its notice of review, published in the February 28 Federal Register, the Service is asking for any new information on the status of the candidate species.

"The revisions to the candidate species list strengthen the scientific basis of the endangered species program," said Service Deputy Director John Rogers. "The new candidate species list clearly identifies those species with strong scientific evidence indicating they are likely to be in need of listing as endangered or threatened. This will enable the Service, other agencies, and private partners to focus attention and resources on the species that most need help and will therefore, ultimately reduce the costs and increase the effectiveness of species conservation."

The revised candidate notice identifies 182 species as "candidates" for listing. "Candidate species" are species for which the Fish and Wildlife Service has enough scientific information to warrant proposing them for listing as endangered or threatened under the Endangered Species Act. Identification of candidate species helps resource managers alleviate threats and thereby possibly remove the need to list species as endangered or threatened. Conservation actions for candidate species are often the most effective and least expensive means for restoring species.

The revised candidate list replaces an old system that listed nearly 4,000 "candidate" species under three separate categories. The old system led many people to the mistaken conclusion that the addition of thousands of species to the endangered list was imminent. Under the revised list, only those species for which there is enough information to support a listing proposal will be called "candidates." These were formerly known as "Category 1 Candidate Species."

With this announcement, the Service will no longer maintain a list of species formerly known as "Category 2 Candidates." These are species for which the Service does not have enough scientific information to support a listing proposal. The Fish and Wildlife Service is working with Federal and state agencies, private conservation groups, and the scientific community to develop

data sharing arrangements and continue to assess the status of these species.

"The Fish and Wildlife Service remains concerned about many of the species formerly on the 'Category 2 Candidates' list, and will continue working with states and others to gather information about these and other species that may be at risk," Rogers said. "However, we currently do not have the type of information needed to warrant a candidate designation for these species."

In the 22-year history of the Endangered Species Act, the Fish and Wildlife Service has listed 960 U.S. species as endangered or threatened but has determined that 2,400 others do not warrant protection at this time. Over 70 percent of all species reviewed were found not to warrant listing.

None of the current candidate species is likely to be listed as endangered or threatened in the near future because of an April 1995 Congressional moratorium on adding new species to the official list. Proposals to list species also have been delayed by reductions in the Service's endangered species budget. The Service is continuing efforts to stabilize the status of candidate species through conservation partnerships but Congress has also cut funding for this program.

Also in the February 28 Federal Register is a notice explaining the changes in the status of 96 candidate species under the terms of a settlement agreement in a lawsuit filed by the Fund for Animals. This notice explains that scientific review has indicated these 88 plants and 8 animals do not warrant proposal for listing as endangered or threatened. Most of the species were removed for taxonomic reasons, because of a lack of scientific information to support a proposal, or because they are more abundant or less threatened than previously believed. Several of the species were removed from "candidate" status as a result of successful conservation actions that have reduced threats and stabilized their populations. Two species, both Hawaiian plants, were removed because they are believed to be extinct.

Need to pay your dues for 1996? Have a friend you'd like to give a gift membership to? Contact Alvin Yoshinaga, membership chairman, for more information or send your check to:

Hawaiian Botanical Society, c/o Department of Botany, 3190 Maile Way, University of Hawai'i, Honolulu, HI 96822

News and Announcements

If you have news or announcememtns that you think would be of interest to Society members please submit them for inclusion in later issues of this newsletter. Submissions can be made care of: Newsletter Editor, Gregory A. Koob, P.O. Box 12191, Honolulu, HI 96828-1191 or via e-mail at koob@hawaii.edu

All Welcome to Join the E-Mail Group, SOS (Save Our Special) Hawaiian Flora.

We have about 30 members, including one mainlander and we range from students, UH staff, and personnel from state, federal and private organizations involved in learning about and saving our flora. So far, we operate basically as a networking group, where we can put out general questions to which members may respond to individually, general interest announcements and contacts with people whose expertise is of interest to us. If you want to join, please contact: Priscilla Millen at (pmillen @hawaii.edu) Hope to see you there.

February Field Trip to Wa'ahila Ridge State Park

Plant Check Lists Available

On February 24, the Botanical Society field trip met at the Wa'ahila Ridge State Park. Dr. Deborah Woodcock of the UH Geography Department took the group to a melaleuca stand just makai of the park, where she is studying native forest regeneration in exotic forestry plantings. Afterwards, Alvin Yoshinaga of the UH Center for Conservation Research and Training led a hike up Kolowalu Trail to see native mesic forest plants. Plant check lists and maps were distributed to the participants. Others wanting check lists can contact Dr. Woodcock at 956-7526 for the melalueca list, or Mr. Yoshinaga at 988-3177 for the Kolowalu list.

Interested in Asteraceae?

Sterling Keeley is looking for someone interested in helping her out on a possible project. If you enjoy "getting your nose dirty" in the library and herbarium this might be for you. She wants to work on a flora treatment of the Vernonieae for the Flora North America. If you would like to learn more about what goes into writing a flora, are interested in taxonomy and systematics ,or would just like to help out, contact Dr. Sterling Keeley at the botany department of UH-Mānoa for more information.

The Kaneohe Outdoor Circle

In Cooperation with

Ho'omaluhia Botanical Gardens

proposes to start a Community Lei Garden. A planning meeting will be held on March 21, 1996 at 10:30 a.m. at Ho'omaluhia Botanical Garden Visitor Center in Kaneohe. The purpose of this meeting is to prepare the groundwork for the selection, planting, and care of lei-producing plants in the Botanical Garden. We hope to include the building of a halau to be used by lei makers.

Please bring lunch and join us in this planning session. If you are able to attend, call 233-7323 to let the staff at Ho'omaluhia know you'll be there.

Outings Sponsored by Lyon Arboretum

For more information on the following outings, call the Lyon Arboretum at 988-3177, Monday through Saturday 9:00 to 3:00. All outings require prior registration and group sizes are limited.

Ka'ena Point Nature Walk: Led by Charles Lamoureux, Arboretum director. Meet at 9:30 at the end of the paved road (Farrington Highway) just past Yokohama Beach on the west coast of O'ahu. Saturday, April 20, 1996, 9:30 to 3:00. $12.00 ($6.00 members).

Bird Walk at Lyon Arboretum: Ornithologist Sheila Conant will first give a brief lecture on the bird life at the Arboretum and then conduct a guided walk. Saturday, May 11, 1996. 8:00 to 11:00. $9.00 ($6.00 members).

Job Anouncement

Time: Fall semester, about August 20th to December 15, 1996.

Location: One position on Maui, one or more on O'ahu.

Qualifications: College degree in botany or biology, or related science. Must have basic knowledge of Hawaiian native plants and of important introduced plants of Hawai'i.

Desired: Some teaching experience and familiarity of locations of native plants in botanic gardens and in the wilderness.

Job Requirements:Teach 16, 3-hour lab sessions for Botany 130, (Plants in the Hawaiian Environment). The lecture portion will be televised. Labs given on Saturday mornings, 9-12.

Contact Priscilla Millen at 455-0285, Math/Science Dept., Leeward Community College, 94-045 Ala Ike, Pearl City, 96782, or e-mail:pmillen@hawaii.edu

Scientist Needs Marine Plants for Study

Lionel Clowes of the Department of Plant Sciences, University of Oxford, is in need of roots tips of members of the Hydrocharitaceae for his work on root apical meristems. Apparently, species in the three genera of the Hydrocharitaceae that float on fresh water (*Enhalus*, *Thalassia*, and *Halophila*) differ from most plants in having a discrete meristem for the root epidermis. The only other plants known to have this are *Pistia* (Araceae) and *Lemna* (Lemnaceae), all plants that float on fresh water.

Dr. Clowes wants to find out whether any of the marine Hydrocharitaceae have roots that are free in the sea water, ie. not growing in mud, sand, etc. Though all three genera (*Enhalus*, *Thalassia*, and *Halophila*) are found in the Pacific, only the last occurs in Hawai'i [according to Dr. George Staples of the Bishop Museum -ed.]. If there are species of these genera that have free-floating roots, Dr. Clowes would like to have some actively-growing roots tips about 5 mm long fixed in any cytological fixative (such as FAA) so that he can microtome longitudinal serial sections through the meristems after embedding in wax. Ten to 20 root tips would be adequate if they are in good condition when fixed. Any species would be welcomed but he would be grateful to have the proper name accompany it. Plants normally rooted in a substrate would probably not have the peculiar meristem but he might examine them if available.

If anyone knows of any of theses plants and can help Dr. Clowes he can be reached at: Department of Plant Science, University of Oxford, South Parks Road, Oxford OX1 3RB. Or you can phone him at Oxford (01865) 275000 or fax at (01865) 275074.

Write Your Representatives

On the following page is a suggested letter, written by Alvin Keali'i Chock that members may want to use to try to convince our representatives in Washinton, D.C. of the importance of the USFWS designating critical habitat for all species presently listed by the Endangered Species Act.

Send letters to:

Senator Daniel Inouye, 722 Hart Senate Office Building, Washington, D.C. 20510

Senator Daniel Akaka, 109 Hart Senate Office Building, Washington, D.C. 20510

Representative Neil Abercrombie, 1140 Longworth Building, Washington, D.C. 20515

Represenative Patsy Mink, 2195 Rayburn Buidling, Washington, D.C. 20515

Dear _____;

The *Endangered Species Act* of 1973 (ESA) was designed to protect species which are in danger of extinction. As you know, Hawaii's flora is extremely distinctive and outstanding because about 90% of the native plants are *endemic,* or found only in Hawai'i and nowhere else in the world. This has resulted in Hawai'i being considered by the National Geographic Society as the 'endangered species capital of the world.' We have a rich heritage of native plants and animals; these are Hawaii's own and if they disappear, they can never be replaced.

One of the provisions of the ESA is Section 4(a)(3) which requires the Secretary of Interior (delegated to the *Fish & Wildlife Service)* to concurrently designate an area which contains an endangered or threatened species, as a **critical habitat.** To date this has not been done. It is one thing to declare a species as threatened or endangered, and it is another thing to protect it. Because of the intertwined biological relationships and complex of plants, insects, land snails, and birds, it is essential that a number of Hawaiian ecosystems which contain these taxa be preserved.

We urge you to request the Department of Interior to immediately designate **those ecosystems containing endangered or threatened species as critical habitats.** This would better protect Hawaii's unique legacy. Thus far the Service has unfortunately determined that they do not need to designate such protections, and even claim that these designations would lead to vandalism! This is far from the truth.

The Sierra Club Legal Defense Fund, on behalf of the Sierra Club, Hawai'i Audubon Society, Hawaiian Botanical Society, and Conservation Council for Hawai'i have in the past requested this action, but with no results to date. We are therefore asking you to assist in this matter which will result in the perpetuation and preservation of these rare species.

We look forward to your cooperation in safeguarding Hawaii's unique birthright.

Sincerely,

Minutes of the Hawaiian Botanical Society

December Meeting

The December 4, 1995 meeting of the Hawaiian Botanical Society was called to order by Camille Barr, president. The minutes were revised and accepted.

The membership chair reported three new members and one additional life membership.

The treasurer, Ron Fenstemacher, reported $2911 in the Society's checking account.

Old business included the sale of remaining Botanical Society T-shirts and Conservation Council posters.

Proposed officers for 1996 were approved unanimously by the membership and are as follows:

- Camille Barr — President
- Wisteria Loeffler — Vice-president
- Vickie Caraway — Secretary
- Ron Fenstemacher — Treasurer

Announcements included the suggestion by Priscilla Millen of the formation of a communication source via e-mail for the membership. Topics to be included are native flora and conservation.

The plant of the month talk was given by Alvin Yoshinaga on the plants of Joseph Rock. The Main speaker was Paul Weissich, speaking about personal recollections of Joseph Rock.

January Meeting

The first 1996 meeting of the Botanical Society was called to order by Camille Barr on Jan. 15. One visitor, William Steiner, was introduced.

The minutes were accepted as read.

The treasurer's report by Ron Fenstemacher reported a net loss of $363 for the 1995 year, ending with a balance of $2241 in the checking account. Lisa Stratton volunteered to audit the books for the year 1995.

Alvin Yoshinaga reminded the members that dues are payable immediately.

New business included a call for volunteers to supply refreshments after meetings and the announcement of the Waianae Kai hike on Jan. 28.

Announcements made by Priscilla Millen were her ongoing work on an e-mail address and the Jan. 19 meeting discussing proposed changes to state laws pertaining to the Endangered Species Act.

Rob Patteson announced future fund-raisers and encouraged participation from the members.

We enjoyed two plant of the month topics, one by Bob Green on *Hoya imperalis* from Malaysia and another presentation on

mangroves, given by Orlo Steele.

Our speaker for the month was Dr. Art Whistler, of the UH Botany Department, who spoke on the medicinal plants of Samoa.

February Meeting

The February 2, 1996 meeting of the Hawaiian Botanical Society was called to order by Camille Barr, president. One guest was introduced.

The January minutes were approved as read.

The 1995 treasurer's books were audited by Lisa Stratton and approved.

One new member, Christina Crooker, was introduced.

Old business included the approval by the Botanical Society's board to join other environmental groups in signing joint letter to the Attorney General, voicing objection to mining actions on Hawaiian Home Lands on the big island. These actions allow the destruction of a large segment of the endangered species *Lipochaeta venosa*, nehe, by a commercial operation by declaring the Hawaiian Home Lands are exempt from state and federal endangered species laws due to the creation of "an economic hardship" by abiding by the law. The state attorney general concluded that the endangered species laws do apply in this case and no exemption would be granted.

Other old business concerning the critical habitat law — Fish and Wildlife may not be held responsible for creating critical habitats of endangered species due to the moratorium on funding from Congress. Sierra Club Legal Defense Fund will be meeting with the clients of the lawsuit on Feb. 7.

Don Gowing noted the passing of Botanical Society member Elizabeth Marks, one of the founders of Pacific Tropical Botanical Gardens, now known as National Tropical Botanical Gardens.

New business included Arron Lowe requesting volunteers for Botanical Society hikes to contact him. The February Wa'ahila Ridge hike will be the last Saturday in Feb.

Greg Koob announced the need for newsletter articles.

Priscilla Millen reported on the public hearing for proposed changes to the state Endangered Species Act, stating most attendees favored loosening restrictions of ownership and decreasing paperwork involved. Alvin Yoshinaga moved to support proposed changes to the state Endangered Species Act and also to support modifications that private individuals can possess plants providing that it does not endanger said plants. Lou Santiago seconded the motion.

Plant of the month was given by Priscilla Millen on *Hibiscus clayii* and the connection between Horace Clay and Leeward Community College.

Speaker of the month was Patrick Conant from the Hawai'i State Department of Agriculture, Plant Pest Control Branch, who spoke about the status of *Miconia calvenscens* containment on O'ahu and Kaua'i.

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